THE RAPIDITY OF DETONATION

A CIRCUMSTANCE of singular interest has recently been revealed in connection with the investigations still being carried on with gun-cotton at Woolwich Arsenal. The experiments made with this powerful explosive have now extended over a period of ten years, and although many discoveries of vital interest have been made by Professor Abel and by Mr. E. O. Brown, who is aiding in the research, the results teach us, before everything, how much more we have yet to learn of the properties of pyroxilin. First of all, the violence of its explosion had to be tamed, then a compressed form of the material was devised, and after that it was shown that, like its sister-explosive, nitro-glycerine, gun-cotton could be violently detonated, if ignited by a charge of fulminate. Gun-cotton, in fact, turns out to be sympathetic, for, according to the energy with which it is inflamed, so it responds in its behaviour: thus, if gently ignited by a spark, the cotton, in the form of yarn, smouldered slowly away; when set fire to by a flame, it burnt up rapidly; if in the form of a charge it was exploded in a mine or a fire-arm, it at once resented the shock and replied with corresponding energy, behaving like gunpowder under similar circumstances; while, lastly, if fired with great violence with a few grains of fulminate, it is detonated with as much force and with the same terrible effect as its instigator.

More recently, as many may have heard, our investigators have succeeded in detonating, or, in other words, exploding to the best advantage, gun-cotton when in a damp condition; and in this state the explosion is every bit as violent as when the material is dry. This grand discovery is naturally of the utmost importance, because, although many objections may be advanced as to the danger of storing and using gun-cotton when dry, the most nervous of us would scarcely hesitate to employ it sopping wet. In this latter condition the material is, strange to say, not only non-explosive, but positively non-inflammable; so much so, indeed, that it would be probably as serviceable in putting out a fire as a wet blanket or a damp towel would be. It can neither be inflamed nor exploded when wet; and further, unless one has the key to its detonation—a little fulminate of mercury—it is of no more value as an explosive than so much wet paper pulp. When placed in contact, however, with a fuse of the proper construction and a cake of dry gun-cotton, to start the action, the wet pyroxiline, as we have said before, detonates as readily as when the moisture amounts to but a fraction of a per cent. Moreover, the quantity of water in the material is really of no importance, for it has been found that for submarine mines, compressed cakes enclosed in a fishing-net and thrown overboard with a dry primer and a fulminate fuse, will explode with just as much energy as when confined in a water-tight steel case.

It is in respect to this detonation, and more particularly to the rapidity of its action, that we desire to speak at the present moment. Recent experiment has shown that the rapidity with which gun-cotton detonates is altogether unprecedented, the swiftness of the action being truly marvellous. Indeed, with the exception of light and electricity, the detonation of gun-cotton travels faster than anything else we are cognizant of. Thus, detonation will run along a line of gun-cotton cakes, placed so as to touch one another. with a rapidity only inferior to that of electricity, setting fire to a charge or conveying a signal, if desired, almost instantaneously. Twenty thousand feet, or nearly three miles per second, is calculated to be its rate of travelling according to Noble's electric chronoscope. In one experiment forty-two feet of the material was fired, and records secured at every six feet; and in this case the results given were most uniform, for the velocity only varied from nineteen to twenty thousand feet per second, the ratio of transit being in no instance less than this.

To form an approximate idea of this extraordinary rapidity, it is necessary to call to mind the rates of travelling of other mediums. Light and electricity we may leave out of the question, as these are immaterial bodies. A bullet usually flies at the rate of 1,300 feet per second, although rifled barrels have been known to project a shot with a velocity of 1,400 feet. Sound is much slower in travelling, for a second of time is required in getting through some 1,100 feet. A quick match of the most delicate construction would probably be longer still in making way, and a train of gunpowder would be left far behind. So it may be safely affirmed, we think, that the detonation of gun-cotton travels more rapidly than any other known medium, with the exception, we repeat, of light and electricity.

It is curious to note that not every detonating or fulminating substance will induce the detonation of gun-cotton. It seems as if a certain number of vibrations require to be set up—a certain key-note to be struck—in order to secure the decomposition of the material. Thus it is found that fulminate of mercury detonates guncotton readily, while again it is also capable of being detonated by itself; so that if a line of compressed cakes is detonated at one end by a charge of fulminate of mercury, the detonation is communicated rapidly from one cake to another, until they are all consumed. Nor does the force diminish at all as it runs along the line, as might perhaps be imagined; if this were the case, the detonation set up at the beginning of a line would only run up to a certain distance, and there come to a full stop, as soon, that is, as the vibrations are insufficient to explode the gun-cotton. This, however, does not happen in actual experiment; and, on reflection, it stands to reason that if the first cake of pyroxilin is capable of firing the second one, the ninety-ninth is just as ready to detonate the hundredth. Thus the detonation can be carried along a line of any length, and the force is as powerful and violent at the end as it was at the beginning.

This property of gun-cotton may obviously be put to valuable use both in industrial and military operations. In any case where it is of importance that a series of blasting or mining charges should be fired simultaneously, their connection together by means of gun-cotton would ensure such a result. True, the same effect could be obtained by means of an arrangement of insulated wires, the charges being detonated simultaneously with the aid of a battery, but such a plan is not always convenient nor practicable. For cutting down palisades, or stout wooden walls, a line of gun-cotton discs exploded in this way would be most efficacious; and a more ready plan of felling timber does not probably exist than that of placing around the stem of a tree a chain or necklace of the explosive in the form of compressed cakes, the detonation of these dividing the trunk as sharply as the keenest axe.

NOTES

WE read in the *Daily News*:—"Mr. Henry Cole, C.B., presided at the annual meeting of the Hanley School of Art, on Monday evening, and after speaking of the results of the South Kensington Museum, said it was his painful duty to announce that this organisation, which had borne such great fruits, and which was so highly prized by the nation, and was so indispensable to the commercial and social progress of this country, was in jeopardy. The Government contemplated changes which were directly opposed to the further development of the Science and Art Department. It had hitherto flourished under a management which ensured individual Parliamentary responsibility, but it was now proposed to hand over South Kensington to the Trustees of the British Museum, who were already fully occupied in their own departments. The management of the British Museum was not such as to make them desirous of seeing it extended to South Kensington, nor were fifty trustees the proper administrators of public money to the amount of hundreds of thousands a year granted to science and art. He appealed to art students throughout the country not to allow the work of the Prince Consort to be destroyed, and the means of their own instruction to be taken away or muddled with old decaying notions. He urged them to call upon their representatives in Parliament—and an election was not far off—to protect their interests and rights from unprincipled invasion; and he offered his humble services, if he could assist them, to preserve the institution which the Prince Consort founded from the hands of the ignorant spoiler. Mr. Melly, M.P., in proposing a vote of thanks to Mr. Cole, spoke in terms of praise of his efforts to spread art and science, and said it would be far more sensible to transfer the British Museum to South Kensington than to place the latter under the management of the British Museum. It was not by following antiquated notions that the work of education was to be carried on, but by adopting the free-trade principle which Mr. Cole had carried out at South Kensington. He was the Cobden and Bright in the education of art and science. He had been in this matter a true free-trader, and in following the public he had served it. Mr. Cole, in responding, offered 50*l.* towards the establishment of a local museum." Surely it is monstrous that while a Royal Commission is sitting to inquire into these matters the Government should thus attempt to make the Commissioners look ridiculous by taking such a step without waiting for their report. This is another instance of the ignorant action of Government in all matters appertaining to Science.

THE *Challenger* reached the coast of Brazil on September 15 last, after a successful but rather stormy voyage across the Atlantic. She was to have left Bahia on September 25 for the Cape of Good Hope.

MR. SCLATER has received a letter from Dr. A. B. Meyer, announcing his return to Vienna after a most successful expedition to New Guinea. Dr. Meyer landed in Mac Cleur's inlet on the west coast, and crossed the main land to the Bay of Geelvink. He has obtained fresh specimens of nearly all the known Paradise-birds, and of one which he belives to be new to science.

THE examination for Natural Science Scholarships, held in common at the same time and with the same papers for Magdalen, Merton, and Jesus Colleges, Oxford, has terminated in the following elections:—At Magdalen College, to the Demyship, Mr. W. W. Jones, of Clifton College; to the Exhibition, Mr. F. J. Bell, of Christ's Hospital. At Merton College, to the Postmasterships, Mr. W. Carter, of Blackburn Science School, and Mr. F. J. Bell, of Christ's Hospital. At Jesus College, to the Scholarship, Mr. E. W. Poulter. It will be seen that Mr. Bell was elected by two colleges and has decided to accept the election to Magdalen. There were fourteen candidates. The election to the Biological Fellowship at Magdalen College took place on Saturday last, when Mr. C. J. F. Yule, of St. John's College, Cambridge, was announced as the successful candidate. The election to the Physics Fellowship at Merton College will not take place until Oct. 30.

WE regret to have to announce the death of M. Jules Pierre Verreaux, Aide-Naturaliste au Musée d'Histoire Naturelle du Jardin des Plantes. M. Verreaux was a great traveller in early life, and enriched the French National Museum by large collections from the Cape and Australia. On his return to Europe, he was for many years scientific assistant to his brother, the late Edward Verreaux, at the Maison Verreaux in the Place Royale at Paris, so well known to naturalists of all countries. After his brother's death, M. Verreaux accepted the office in the Jardin des Plantes, which he held until his decease. M. Verreaux had a very complete and extensive knowledge of the class of birds, and was the author of numerous ornithological memoirs and papers. His loss will be severely felt by ornithologists who have occasion to consult the rich collection in the Jardin des Plantes, and by many friends and correspondents in this country and elsewhere.

WE have also to record the death of Dr. Otto Wacherer, a German physician, resident at Bahia, who made large collections in various branches of Natural History, and was the author of an excellent memoir on the Ophidians of that district of South America, published in the Zoological Society's "Proceedings."

DR. BESSELS, of the *Polaris* expedition, has given evidence that the death of Captain Hall was solely due to natural causes.

SIR C. B. ADDERLEY, M.P., speaking at the annual meeting of Saltley Reformatory yesterday, expressed his satisfaction at the undoubted diminution of crime in this country. He did not attribute the decrease to any change in our system of secondary punishments but to the gradual spread of education and enlightenment, more especially among the lower classes.

ON November 18 there will be an election at Balliol College, Oxford, to a scholarship on the foundation of Miss Hannah Brackenbury, "for the encouragement of the Study of Natural Science;" worth 80*l.* a year (and tuition free) for four years: open to all such candidates as shall not have exceeded eight terms from Matriculation. At ten o'clock, A.M., papers will be set in the following subjects:—(1) Mechanical Philosophy and Physics; (2) Chemistry; (3) Physiology; but candidates will not be expected to offer themselves in more than two of these. There will also be a practical examination in one or more of the above subjects, if the examiners think it expedient. Candidates are requested to communicate their intention to the Master of Balliol by letter, on or before Monday, November 10, enclosing testimonials from their colleges or schools, and (if members of the University) certificates of their Matriculation; and stating the subjects in which they offer themselves for examination.

WE have received the List of the Candidates who took Honours at the May Examination of Science Schools and Classes in connection with the Science and Art Department. We are sorry that our space does not permit us to publish the list of names, which we are glad to see is very large; it is, moreover, very gratifying to notice that in nearly every department a considerable proportion of the successful Candidates have been "self-taught."

THE following science-teachers, who attended the special course of instruction in magnetism and electricity to science-teachers, in connection with the Science and Art Department, having passed first class, are registered as qualified to earn payments in magnetism and electricity:—T. N. Andrews, G. Armstrong, T. Bayley, J. Bresland, R. Brown, W. Cook, S. Cooke, J. Hamilton, H. Harris, J. Harte, D. Low, S. G. Maunder, A. J. Rider, A. Robinson. J. Sayle, J. Simpson, C. Symons, P. H. Trachy, J. Webb, J. W. Woods. The following for the same reason are registered as qualified to earn payment in acoustics, light, and heat:—J. Alexander, T. J. Baker, S. Barbour, J. Beavis, G. R. Begley, P. Doyle, J. B. Duckett, T. Elliott, T. Isherwood, G. Jeffrey, L. M. Leader, E. Leech, E. Magennis, J. Marsahll, J. Moylan, W. Patterson, E. Reynolds, L. J. Ryan, J. Schofield, G. Severs, W. J. Snowdon, W. Sturgess, C. Symons.

THE name of Dr. Kaup, whose death we noted last week, was inadvertently misspelled "Kemp." Jean Jacques Kaup was Grand-ducal Inspector of the Natural History Museum of Darmstadt.

SIR SAMUEL AND LADY BAKER, it is said, have accepted an invitation from the Geographical Society of New York to visit that city during the summer months of next year.

The inaugural lectures in connection with the scheme of education adopted by the University of Cambridge for the town of Nottingham, were delivered on the 9th inst. in the Lecture Hall of the Mechanics' Institution of that town, and were largely attended. Mr. E. B. Birks, M.A., Fellow of Trinity, who has been appointed to conduct classes and to lecture on English Literature, gave his inaugural lecture in the afternoon to a large audience, composed principally of ladies, for whom this subject has been specially selected; and in the evening Mr. V. H. Stanton, M.A., Fellow of Trinity, who had been appointed to teach Political Economy, opened his course. On Friday week Mr. T. O. Harding, B.A., B.Sc., Fellow of Trinity, commenced his instruction in "Force and Motion," the introduction to Physical Science. The Session will continue to next April, and will be divided into two terms. For the second term, which will commence after Christmas, arrangements have been made for the study of Astronomy, Physical Geography, and English Constitutional History. Examinations will be held at the conclusion of each Term in the work done, and University Certificates will be granted to those who succeed in them.

We learn from the *Bulletin International* of the Paris Observatory, that Lieutenant Parem and Dr. Wykander, while passing the winter of 1872-3 on the coast of Spitzbergen, made a series of spectrum observations on the Aurora, and determined seven different spectral lines, which, according to Wykander, are identical with the spectrum at the bottom of the flame of a candle or petroleum lamp

Messrs. Routledge & Sons, have in the press, a "New Illustrated Natural History," by the Rev. J. G. Wood, M.A., with 500 Illustrations; and "The Book of African Travel," by W. H. G. Kingston. This work is intended to give records of the journeys of all the celebrated travellers in Africa down to the present time. It will be profusely illustrated.

Messrs. Hodder and Stoughton will shortly publish "Life, Wanderings, and Labours in Eastern Africa," with an account of the first successful ascent of the equatorial snow mountain Kilima Njara, and remarks on the East African slave trade, by the Rev. Chas. New, of the Livingstone Search and Relief Expedition, illustrated.

The annual migration of the butterfly from east to west across the isthmus of Panama in August and September was, according to the *Star*, proceeding. The butterfly has golden green stripes on a black ground, and is very beautiful. It has been recognised by Mr. O. Salvin, of London and Guatemala, as the *Urania fulgens.*

We have received the diminutive prospectus of what is likely to be at least an ingenious and curious work; it is entitled "Chemistianity," and will contain "2,000 chemical facts, relating to inorganic chemistry, explained within 5,000 lines of oratorical verse, compiled by permission from the works of leading chemists of the day; together with the views of the author (expressed in verse) as to the advantages of a general knowledge of chemistry." If the book is readable it will certainly be a triumph of ingenuity, if not of genius, on the part of the author, Mr. J. C. Sellars, manufacturing chemist, Birkenhead, who is also publisher.

In the *Chemical News* for Oct. 17 will be found a long list of subjects for prizes to be awarded in May 1874, by the Société Industrielle de Mulhouse.

The first three parts are published (price 6*d.* each) of "British Marine Algæ; being a popular account of the Seaweeds of Great Britain, their collection and perservation," by W. H. Grattann. It is intended as a cheap and popular rather than scientific handbook to our marine flora, and will apparently serve a very useful purpose as such. The illustrations, though on a small scale, are sufficient to recognise the more striking forms.

The last two parts, xi. and xii., of the new edition of Griffith and Henfrey's Micrographic Dictionary, bring down the work as far as Hydra. The botanical articles have been written up to the present state of science by the Rev. M. J. Berkeley.

Mr. A. Elley Finch has published the lecture he delivered last March before the Sunday Lecture Society, "On the Pursuit of Truth." We think he has done well in so doing, as he shows clearly and shortly the only principles of evidence upon which permanent and satisfactory belief can be founded, showing the distinction between the evidence which satisfies the theologian, the lawyer, and the man of science. Mr. Finch has added many footnotes and appendices, which, though often irrelevant, are in most cases valuable and interesting, the appendices being mostly abstracts of passages from the works of well-known authors bearing more or less on the subject alluded to in the lecture. We wish the lecture a large circulation among the general public, whom it would tend to enlighten.

The *Gazette de Vos* publishes some statistics with regard to education in Germany, which appear in *La Nature.* According to the latest official information, the German Empire numbers 380 gymnasiums, pro-gymnasiums, and academies (*lycées*); 156 Latin schools (in Bavaria and Wurtemberg); 270 "realschulen," 12 high schools, technical and polytechnic. Prussia possesses besides, 26 provincial schools of arts and industry; Saxony, 5 commercial schools and 4 schools of arts, industry, and architecture; Saxe-Coburg-Gotha, 3 schools of the kind last mentioned; the City of Hamburg possesses a school of art for boys and another for girls. Bavaria has 33 schools of arts, commerce, and agriculture; Prussia, 26 agricultural schools, with 41 winter schools of rural economy. The rest of the German Empire possesses 56 other schools belonging to one or other of these categories. Prussia numbers 260 superior public schools for girls, and the rest of Germany, 54. 143 seminaries for the training of teachers are in full activity in the German Empire during the present year; primary instruction is given in 60,000 schools. All the German States have schools for deaf-mutes and for the blind; Prussia possesses 35 for the former and 14 for the latter. With regard to schools for the artistic professions, Bavaria occupies the first rank, but Wurtemberg and Prussia have latterly made great progress in this direction.

"The Pearl of the Antilles; or, An Artist in Cuba," by Walter Goodman, is the title of a volume just published by Messrs. King & Co. Since Mr Goodman calls himself an artist, we should have expected a few illustrations of Cuban scenery in his work, but there are none. The work makes no pretensions to be a contribution to the natural history of Cuba, but in a very entertaining manner the author gives a series of sketches of social life on the lovely island.

The additions to the Zoological Society's collection during the past week include two Weka Rails (*Ocydromus australis*) from New Zealand, presented by the Acclimatisation Society of Otago; an Alligator (*Alligator mississipiensis*) from New Orleans, presented by Capt. M. Cowper; two Patagonian Conures (*Conurus patagonus*) from Chili, two Solitary Tinamous (*Tinamus solitarius*) from Brazil, received in exchange; a Macaque Monkey (*Macacus cynomolgus*) and a Bonnet Monkey (*M. radiatus*) from India, presented by Mr. G. Veitch, and deposited; a Cape Petrel (*Daption capensis*), purchased, from Manilla, which is the first specimen of this bird obtained by the Society.